Field Modification Form
Lower Passaic River Restoration Project
Remedial Investigation
Project No: 436870.01.AF

Field Modification Number: FM-130322-1
Document (plan or SOP title and date)
Lower Passaic River Study Area, River Mile (RM) 10.9 Characterization Quality Assurance Project Plan (QAPP) Addendum D - Sediment Collection to Support Removal Action Design and Dredge Material Characterization. Revision 1. February 2013.
Activity: Groundwater Seepage Investigation
Proposed Modification: The field program outlined here is proposed to collect site-specific data to support the cap design for the RM 10.9 Removal Action. The proposed field activities are scheduled to commence during the week of April 8, 2013, and include direct measurement of groundwater seepage (upwelling) velocity through the river bed at the RM 10.9 Removal Area. Direct measurements of groundwater flux through the sediments in the RM 10.9 Removal Area will be obtained through the temporary installation of ultrasonic seepage (UltraSeep) meters. CH2M HILL has contracted with Coastal Monitoring Associates (CMA) to install the UltraSeep meters, which will be accomplished using divers. CMA has extensive experience implementing this technology on a wide range of sediment sites and has worked directly for the United States Environmental Protection Agency (US EPA) on some of these sites. UltraSeep meters perform time-series flow rate measurements, which capture both positive and negative discharge at the surface water / sediment interface. This time-series information is particularly important in tidally influenced environments. The UltraSeep meters will be installed at the four monitoring locations, shown in Figure 1 (along the -4 ft bathymetry contour), and will be programmed to continuously monitor seepage velocity for 2.5 to 3 days. This bottom depth was chosen to allow the meters to be submerged throughout the tidal cycle. Each Ultrasonic Submerged Flow-Only (SFO) unit is self-contained and mounted within a 72 cm diameter by 58 cm high cylindrical stainless steel frame. No water samples will be collected as part of this field investigation. CMA's standard operating procedure (SOP) for installation and operation of the UltraSeep meters is provided in Attachment A. The UltraSeep meter data will provide information on the variation in groundwater flux associated with the tidal cycle. Although the UltraSeep meters can work with periods of no water, the absence of water will produce data gaps. Therefore, to obtain an uninterrupted dataset, it is best to keep the meters entirely submerged during data collection. Results from the field investigation will be provided within 15 days after completion of the field investigation.
Effective Date: April 2013
Rationale: The proposed field activities were requested by US EPA. The data that will be generated as part of this field investigation will be critical input parameters to the numerical model CapSim (version 2.6; Reible 2012), which is being used to predict the potential transport of select chemicals of potential concern (COPCs) through the active layer. The CapSim model estimates pore water concentrations through and above the various cap layers, which are determined by contaminant migration from the sediment below the cap (i.e., the sediment remaining after dredging). Once groundwater seepage velocity data (and pore water concentrations, which were collected as part of the February 2013 QAPP Addendum D activities) are available, the model will be run with these site-specific data and a final design for the chemically active layer will be proposed.

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Submitted by: CH2M HILL	**Date:** March 21, 2013
FTM Manager Approval:	**Date:**
Project QA Manager Approval:	**Date:**
Task Manager Approval:	**Date:** March 20, 2013

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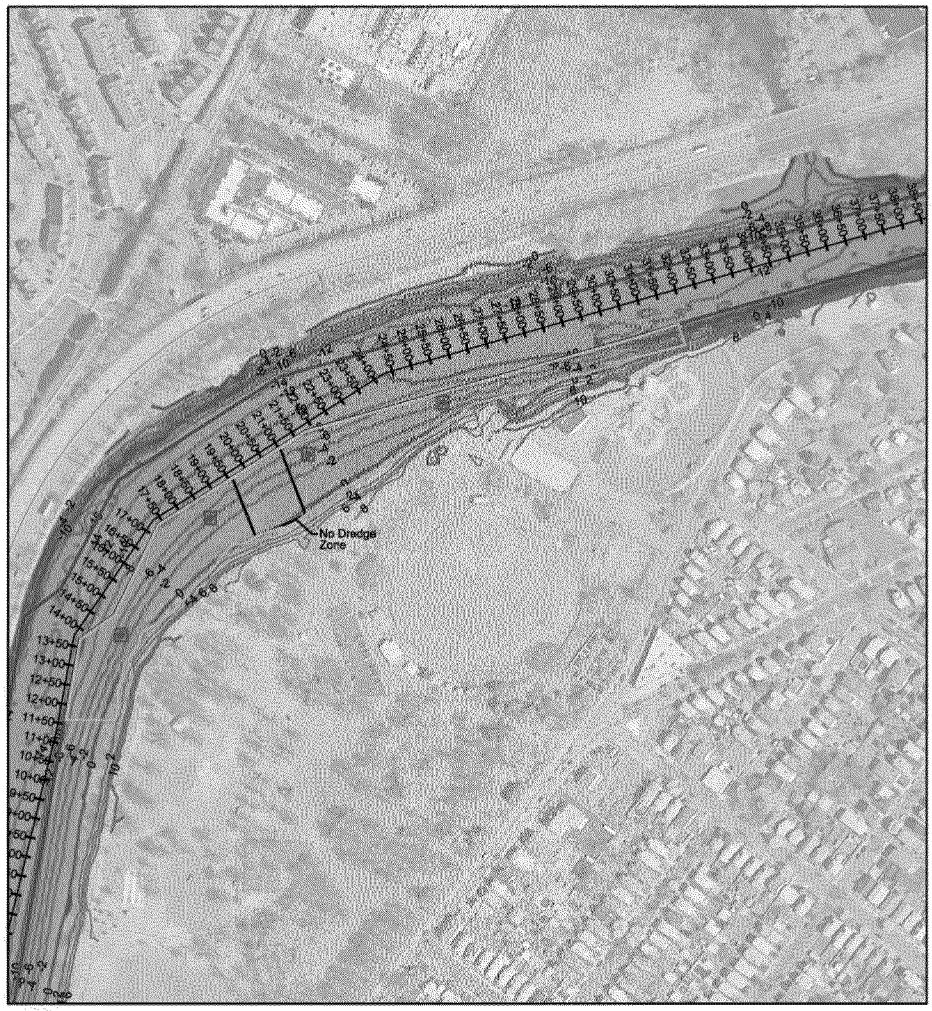

Notes:

1. Orthophoto: NJGIS, 2007
2. Contour Interval = 2 ft NGVD29
3. The bathymetry contours shown are generated from the most current bathymetric survey data: October 2011multibeam survey (GBA, 2011) joint to the July 2011 single-beam survey (CH2M HILL and AECOM, 2012)

LEGEND

- GW Seepage Measurement Locations
- Navigation Channel
- Cap Area Boundary
- 22+50 Transect Station Annotation

N

0 300 FEET

Figure 1. Proposed Groundwater Seepage Measurement Locations

CH2MHILL

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Attachment A: UltraSeep Standard Operating Procedure

THE ULTRASEEP SYSTEM

Technology Description

The seepage technology utilized is based on the patented time-transient ultrasonic groundwater seepage meter described by Paulsen et al (2001). The UltraSeep system is a seepage meter system for quantifying discharge rates and chemical loading from groundwater flow to coastal waters. Traditional seepage technology was modified and improved to include automated multiple sample collection and continuous flow detection with ultrasonic flow meters. The resultant instrument, the UltraSeep, makes direct measurements of advective flux and contaminant concentration at a particular location (Chadwick et al., 2003). The data produced are time series, over tidal cycles, of groundwater flow, contaminant concentration, and associated sensor data. This allows an accurate determination of the presence or absence of groundwater flow into a bay or estuary.

The commercial version of the UltraSeep Meter performs continuous, direct measurement of groundwater seepage rates using the time transient ultrasonic technique described by Paulsen et al. (2001) (Figure1). The meter relies on a Teflon-coated, stainless steel, open-bottomed chamber measuring 50 cm in diameter to funnel the seepage water to the flow sensor. The flow sensor is connected to the funnel via 12 mm Teflon tubing, allowing free flow of water between the funnel and the outside environment. Data from the flow meter and a temperature/conductivity sensor housed within the funnel are monitored by an integrated data logger/controller unit (DLC). All of these components, along with a 12 V submersible battery housing, are mounted within a 72 cm diameter by 58 cm high cylindrical stainless steel frame.

The ultrasonic flow sensor uses two piezoelectric transducers to continuously measure the travel times of ultrasonic waves along the flow path of the seepage water through the flow tube. As water enters the flow tube, it passes through the ultrasonic beam path. The ultrasonic signal that travels with the flow has a shorter travel time than the signal traveling against flow. The perturbation of travel time is directly proportional to the velocity of flow in the tube. The flow sensor sensitivity is about 1.5 cm^3/min which, given the amplification from the funnel, translates to a seepage rate of 0.1 cm/d. This sensitivity can be further improved by signal averaging.

The DLC provides the primary data logging and control functions for the UltraSeep meter. The DLC allows programmable logging and control via analog, digital and RS-232 signals. For the UltraSeep system, the flow sensor data is recorded as an RS-232 signal. Typically, the control program evaluates this signal for a five minute averaging time and, based on the laboratory flow calibration, determines the current seepage rate.

In operation, the UltraSeep meter is lowered to the bottom either directly from a boat, by divers using a lift-bag, or by wading. Once the unit is settled on the bottom, the seal is checked. A period of 2-3 h is generally allowed to insure that any transient seepage response associated with the deployment activities has dissipated. The DLC unit then initiates logging and control functions. At coastal sites, a typical deployment runs over a 12-24 hour period to capture an entire semi-diurnal or diurnal tidal cycle, although the system can be run continuously for a period of up to about 4 days. During this period, the seepage rate is continuously monitored. At the end of the deployment, the meter is recovered using either a lift line to the recovery boat, by diver assistance, or by wading.

Operating Steps

- Meter is calibrated in the lab.
- Meter is carefully deployed to the site.
- Meter is mobilized to the station and lowered to the bottom.
- Meter is carefully inserted into the bottom 10cm.
- Diver inspects the installation insuring a complete seal to the bottom.
- Valves are closed and the meter is left for 1 hour to eliminate installation influences.
- After 1 hr the valves are opened by the diver and the meter logs flow continuously for up to 3-4 days depending on battery charge life. The flow path is open to the river allowing for equally accurate measurements in both directions. This allows quantification of tidal pumping and tidal influences as they interact with hydraulic gradient from the shoreward aquifer.
- The meter is monitored daily for logging and any problems corrected.
- At the end of the deployment the diver closes the valves to a zero flow condition, and the meter is left recording for 1 hr.
- The data is then downloaded and the meter is returned to shore and demobilized.

Figure1. The UltraSeep system.

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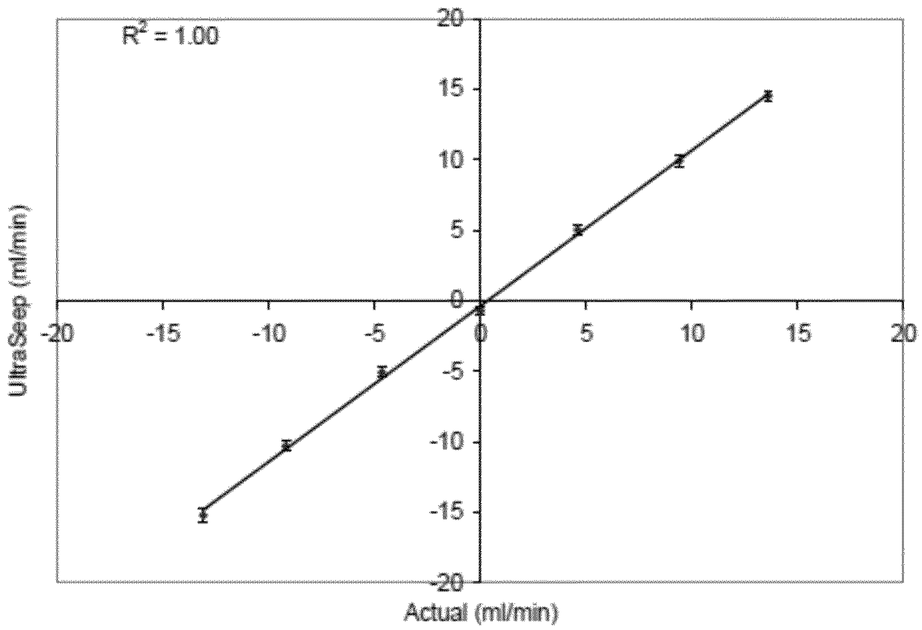
SEEPAGE METER CALIBRATION

The ultrasonic flow meters are calibrated prior to the study. Calibrations are carried out with a highly accurate, low-flow peristaltic pump. Five flow rates are run through the flow meter, generally ranging from about -15 ml/min to +15 ml min. Figure 6 shows a typical calibration run for a US meter. Typical calibration results for each of the seepage meters are summarized in Table 2. The table summarizes theslope, regression coefficient (R_2), and the resulting calibration factor K_c = (slope –1)*100%.



SPECIFIC DISCHARGE DATA ANALYSIS

Ultrasonic seepage data for the meters are processed to determine specific discharge rates. Data from the three meter types are processed in essentially the same way. Raw data from the meter are recorded as a flow rate, generally in units of L/min. These flow data are converted to specific discharge based on the geometry of the flow tube and seepage funnel as where Q is the flow rate measured by the ultrasonic flow meter, and A_f is the area of the funnel. The UltraSeep utilizes a round funnel with a diameter of 50 cm and an area of 1963 cm_2. The BS and SFO meters utilize a square funnel with dimensions of 45.72 cm on each side, and an area of 2090 cm_2.

$$D = \frac{Q\left(\frac{L}{min}\right) \times 1000\left(\frac{cm^3}{L}\right) \times 1440\left(\frac{min}{day}\right)}{A_f\left(cm^2\right)}$$